Proposal topic: Linking hydrologic regime and stoichiometric imbalance in streams

BACKGROUND AND LITERATURE REVIEW

**Ecological stoichiometry and the balance of resource supply and demand**

Stoichiometry is the measurement of quantitative relationships between chemical constituents that are involved in, and produced by, chemical reactions. In ecological stoichiometry it is the balance between biologically important chemical elements in ecological interactions that is of interest. Ecological stoichiometry has been put forth as a conceptual framework that increases mechanistic understanding of complex ecological dynamics by distilling them into mass balance relationships (Elser et al. 1996, Sterner and Elser 2002). Using ecological stoichiometry, for example, food web interactions can be examined by congruence of Elemental ratios of biological supply and demand, and causes and consequence of a lack thereof (Sterner et al. 1996, Schade et al. 2005). Under stable conditions a species in relative stoichiometric balance with a given resource supply will have fewer food quality constraints on growth and reproduction, and thus gain a competitive advantage over other species within a functional group (Sterner and Elser 2002). Yet conditions are not often stable in natural systems, and temporal and spatial heterogeneity can alter supply ratios at different scales. Factors external to communities-such as temperature, disturbance regime, and solar radiation-provide a "stoichiometric template" (Schade et al. 2005), defining the range of stoichiometric responses of communities to supply ratios (Elser et al. 2000, Woods et al. 2003). Such factors may drive and/or maintain stoichiometric imbalances, acting against forces such as natural selection that over evolutionary time should bring organisms towards stoichiometric balance with their food (Redfield 1958, Sterner et al. 2004). Despite the influence of these external factors on elemental cycles in ecosystems, their identities, and importance are often unclear.

**Hydrologic disturbance and stochiometric balance in benthic systems**

Ecologists are just beginning to recognize external factors that form the stoichiometric

template at broad scales in streams (e.g anthropogenic nutrient enrichment; Bowman et al. 2005).

Hydrologic regime is likely a significant determinant of the stoichiometric template because of

its influence on community structure and dissolved nutrient availability on broad scales. During

floods, high discharge can suspend sediments, reduce nutrient availablity, move and redistribute

benthic material, remove algae by scouring the streambed, and kill or displace biota (Lake 2000,

Holmes et al. 1998). By subjecting organisms to a harsh environment characterized by scouring,

extreme flow events can alter relative densities of consumers and their prey (Peckarsky 1983).

Since benthic species often differ in elemental composition (Cross et al. 2003, Evans-White et al.

2005), hydrologic events that drive the identity and relative densities of biota can change system-wide

stoichiometric patterns of resource supply and demand (Schade et al. 2005). Hydrologic

disturbance can also reduce dissolved nutrient availability, which can change the stoichiometry

of benthic producers that serve as food resources to higher trophic levels (Holmes et al. 1998).

The hydrologic regime has the potential to alter elemental patterns in benthic systems by

mediating community structure and dissolved nutrient availability, but links between stoichiometric imbalance and hydrologic disturbance have not been examined. The proposed research would provide information to improve our ability to predict consequences-ranging from impacts on biogeochemical cycles to food quality constraints on individual organisms - of human modification of hydrologic regimes.